Mutagenic Evaluation of Compound FDA 71-19 (**Sodium Bicarbonate**) 10/9/74

D35

LBI PROJECT #02468

D35

MUTAGENIC EVALUATION OF COMPOUND FDA 71-79 SODIUM BICARBONATE

SUBMITTED TO

FOOD & DRUG ADMINISTRATION
DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
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Appendix - Summary of Tests Evaluating DMSO for Genetic Activity in *Salmonella* and *Saccharomyces*

EVALUATION SUMMARY

Compound FDA 71-79, sodium bicarbonate, was not genetically active, either directly or in the presence of organ homogenates, in any of the *in vitro* assays employed in this evaluation.

DATE: October 1, 1974

SPONSOR: Food and Drug Administration, Contract Number 223-74-2104

SUBJECT: Mutagenic Evaluation of Compound FDA 71-79

I. OBJECTIVE

The objective of this study was to assess the genetic activity of the test material in microbial assays with and without the addition of mammalian metabolic enzyme preparations.

II. MATERIALS

A. Test Material

Sodium bicarbonate

J.T. Baker #43386

B. Tissue Homogenates and Supernatants

The tissue homogenates and 9,000 x g supernatants were prepared from liver, lung and testes of the following mammalian species: Mouse - ICR random bred adult males; rat - Sprague-Dawley adult males; and primate - Macaca mulatta adult males.

C. Indicator Organisms

The indicator organisms used for all tests are described below:

- Saccharomyces cerevisiae, strain D4: $\frac{\alpha}{a}$, $\frac{\text{ade 2-2}}{\text{ade 2-1}}$, $\frac{\text{try 5-12}}{\text{try 5-27}}$

- Salmonella typhimurium, strains:

  TA-1535; hisG, uvrB, rfa (missense mutation)
  TA-1537; hisC, uvrB, rfa (- frameshift mutation)
  TA-1538; hisD, uvrB, rfa (+ frameshift mutation)

D. Reaction Mixture

The following reaction mixture was employed in the activation tests:

	Component	Final Concentration/ml
1.	TPN (sodium salt)	6 µM
2.	Isocitric acid	49 µM
3.	Tris buffer, pH 7.4	28 µM
4.	$MgCl_2$	1.7 µM
5.	Isocitric dehydrogenase	6.3 Units
6.	Tissue homogenate or cell fraction	72 µM

Components 1-4 were combined and frozen as a "core" reaction mixture to which the other components were added just prior to use.

E. Positive Control Compounds

Table 1 lists chemicals for positive controls in the direct and activation assays.

TABLE 1

POSITIVE CONTROLS USED IN DIRECT AND ACTIVATION ASSAYS

ASSAY	CHEMICAL[a]	SOLVENT	PROBABLE MUTAGENIC SPECIFICITY[b]
Non-activation	Ethylmethane sulfonate	Water or saline	BPS
	2-Nitrosofluorene	Dimethylsulfoxide[c]	FS
	Quinacrine or Quinacrine mustard	Water or saline	FS
Activation	Dimethylnitrosamine	Water or saline	BPS
	2-Acetylaminofluorene	Dimethylsulfoxide[c]	FS

[a] Concentrations given in the Results Section.

[b] BPS = base-pair substitution; FS = frameshift.

[c] Previously shown to be non-mutagenic, see Appendix.

III. METHODS

A. Toxicity

The solubility, toxicity and doses for all chemicals were determined prior to screening.

Each chemical was tested for survival against strains TA-1537 and D4 over a range of doses to determine the 50% survival dose. Bacteria were tested in phosphate buffer, pH 7.4, for one hour at 37°C on a shaker. Yeasts were tested in phosphate buffer, pH 7.4, for four hours at 30°C on a shaker. The 50% survival dose was determined from the survival curve and the 1/4 and 1/2 50% doses calculated.

If no toxicity was obtained for a chemical with a given strain, then a maximum dose of 5% (w/v) was used against the strain.

Unless otherwise specified, the doses calculated for the tests in buffer were applied to the activation tests. The solubility of the test chemical under treatment conditions is stated in the Results Section.

B. Plate Tests

Only three bacteria strains were tested in qualitative plate tests. In the non-activation procedure, approximately 10^9 cells of a log phase culture of the bacterial indicator strains were spread over the surface of a minimal plate, and a measured amount of the test chemical was placed in the center of the test plate. In activation tests, the test chemical was added to the cells, and an aliquot of the mixture was spread on the surface of the test plate. The reaction mixture (0.1 ml) plus tissue extract was then spotted on the surface of the plate. Positive and solvent controls were included. All plates were incubated at 37°C for four days and then scored. Each compound (Test, Positive Control and Solvent Control) was done in duplicate. The results were scored as + or -. Concentrations of the positive control compounds are listed in the Results Section.

C. Suspension Tests

1. Non-activation

Log-phase bacteria and stationary-phase yeast cultures of the indicator organisms were grown in complete broth, washed and resuspended in 0.9% saline to densities of 1×10^9 cells/ml and 5×10^7 cells/ml, respectively. This constituted the working stock for tests of a group of test chemicals and their respective controls. Tests were conducted in 30 ml plastic tissue culture flasks. Cells plus appropriate volume(s) of the test chemical were added to the flasks to give a final volume of 2 ml. Solvent replaced the test chemical in the negative controls. Treatment was at 30°C for four hours for yeast tests and at 37°C for one hour for bacterial tests. All flasks were shaken during treatment. Following treatment, the flasks were set in ice. Aliquots of cells were removed, diluted in sterile saline (4°C) and plated on the appropriate complete media. Undiluted samples from flasks containing the bacteria were plated on minimal selective medium. Samples from a 10^{-1} dilution of treated cells were plated on the selected media for enumeration of gene conversion with strain D4. Bacterial plates were scored after incubation for 48 hours at 37°C. The yeast plates were incubated at 30°C for 3-5 days before scoring.

2. Activation

Bacteria and yeast cells were grown and prepared as described in the non-activation tests except that the cell densities were increased approximately five-fold for working stock suspensions. Measured amounts of the test and

control chemicals plus 0.25 ml of the stock cell suspension were added to a 30 ml plastic tissue homogenate. All flasks (bacteria and yeast) were incubated at 37°C with shaking. The treatment times as well as the dilutions, plating procedures and scoring of the plates were the same as described for non-activation tests.

D. Preparation of Tissue Homogenates and 9,000 x g Cell Fractions

1. Mice

Male mice (sufficient to provide the necessary quantities of organs for testes, lung and liver homogenates) were killed by cranial blow, decapitated and bled. The three organs were immediately dissected from the animal using aseptic techniques and placed in ice-cold 0.25 M sucrose buffered with Tris at pH of 7.4. Upon collection of the desired quantity of organs, they were washed twice with fresh buffered sucrose and completely homogenized with a motor-driven homogenizing unit at 4°C. The whole organ homogenate obtained from this step was divided into two samples. One sample was frozen at -80°C and the other was centrifuged for 20 minutes at 9,000 x g in a refrigerated centrifuge. The supernatant from the centrifuged sample was retained and frozen at -80°C. These two frozen samples were used for the activation studies.

2. Rats

The same procedures as described for mice was used for this mammal.

3. Primates

The liver, lungs and testes were aseptically removed from freshly killed adult male rhesus (M. mulatta) monkeys. Each organ was cut into a number of pieces each sufficient for one week's studies. The tissues were labeled and frozen at -80°C until needed. Tissue homogenates and 9,000 x g supernatants were prepared as described for mice.

E. Data Recording and Reporting

Following the specified incubation periods all population plates were scored by an automatic colony counter and the results from each plate of a set was recorded, in ink, in bound data books. Information necessary for identification of the specific experiment as well as the presence of any contaminant micro-organisms was recorded with each set of plate counts. All minimal or other types of selective media plates were hand scored and the results recorded along with the respective population data. For bacteria strains the number of colonies recorded from either the population or selective plates represents that number in 1 ml of test suspension plated. The numbers recorded for the yeast strain D4 represent the number in 0.5 ml of test suspension plated.

Frequencies were mechanically calculated and double checked. All data presented in the Results Section of this report consists of the actual sum of all raw data plate counts and only the frequencies are calculated figures.

IV. SOLUBILITY PROPERTIES OF THE TEST COMPOUND

1. NAME OR DESCRIPTION OF TEST COMPOUND: FDA 71-79
   SODIUM BICARBONATE

2. TEST SOLVENT AND DESCRIPTION OF SOLUBILITY OF THE TEST CHEMICAL UNDER TREATMENT CONDITIONS: 0.067 M phosphate buffer, pH 7.4, was used as the solvent for this compound, and the compound was soluble under treatment conditions in all tests with bacteria indicators. Some precipitation occurred at the high dose in the D4 yeast tests.
3. OTHER COMMENTS:

		D4	TA-1537
Range of concentrations of the test compound used to determine the 50% survival level	Dose No.	% Concentration	% Concentration
	1	1	1
	2	2	2
	3	3	3
	4	4	4
	5	5	5
Survival Results Test Date: 7-8-74	Dose No.	% Survival	% Survival
	Control	100	100
	1	100	97
	2	100	72
	3	100	53
	4	95	28
	5	84	17
Concentrations of the test chemical required for mutagenicity tests	Dose	% Concentration	% Concentration
	Plate Test	-	1.5%
	¼ 50% Survival	2.0%	0.75%
	½ 50% Survival	4.0%	1.5%
	Other 50%	8.0%	-

VI. NON-ACTIVATION PLATE TESTS

DATE: 8-30-74

Test	Compound	Concentration/plate	TA-1535 T-1	TA-1535 T-2	TA-1537 T-1	TA-1537 T-2	TA-1538 T-1	TA-1538 T-2
PC	EMS	0.05 ml undiluted chemical	+	+				
	QM	0.25 mg			+	+		
	NF	0.25 mg					+	+
SC	SALINE	-	-	-	-	-		
	DMSO	<10%					-	-

NOTE: PC = positive control
SC = solvent control
T-1 = trial 1
T-2 = trial 2
EMS = ethyl methanesulfonate
QM = quinacrine mustard
NF = nitrosofluorene
DMSO = dimethyl sulfoxide
(c) = contamination present

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NON-ACTIVATION PLATE TESTS

DATE: 8-30-74

Test	Compound	Concentration	TA-1535		TA-1537		TA-1538	
			T-1	T-2	T-1	T-2	T-1	T-2
TC	FDA 71-79	1.50%	-	-	-	-	-	-

NOTE: TC = test compound
T-1 = trial 1
T-2 = trial 2

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VII. ACTIVATION PLATE TESTS

SPECIES: MOUSE

DATE: 8-30-74

Test	Organ	Compound	Concentration/plate	TA-1535 T-1	TA-1535 T-2	TA-1537 T-1	TA-1537 T-2	TA-1538 T-1	TA-1538 T-2
PC	Li	DMNA	25 µmoles	+	+				
		AAF	1.25 mg			+	+	+	+
	Lu	DMNA	25 µmoles	+/-	+/-				
		AAF	1.25 mg			-	-	-	-
	T	DMNA	25 µmoles	-	-				
		AAF	1.25 mg			-	-	-	-
SC	-	DMNA	25 µmoles	-	-				
	-	AAF	1.25 mg			-	-	-	-
	-	Saline	-	-	-				
	-	DMSO	<10%			-	-	-	-

NOTE:
PC = positive control
SC = solvent and chemical controls
AAF = 2-acetylaminofluorene
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes
T-1 = trial 1
T-2 = trial 2
DMSO = dimethyl sulfoxide
(c) = contamination present

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ACTIVATION PLATE TESTS

SPECIES: MOUSE DATE: 8-30-74

Test	Organ	Compound	Concentration	TA-1535 T-1	TA-1535 T-2		TA-1537 T-1	TA-1537 T-2		TA-1538 T-1	TA-1538 T-2
TC	Li	FDA 71-79	1.50%	-	-		-	-		-	-
	Lu	FDA 71-79	1.50%	-	-		-	-		-	-
	T	FDA 71-79	1.50%	-	-		-	-		-	-

NOTE: TC = test compound
Li = liver
Lu = lung
T = testes
T-1 = trial 1
T-2 = trial 2

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ACTIVATION PLATE TESTS

SPECIES: RAT

DATE: 8-30-74

Test	Organ	Compound	Concentration/plate	TA-1535 T-1	TA-1535 T-2	TA-1537 T-1	TA-1537 T-2	TA-1538 T-1	TA-1538 T-2
PC	Li	DMNA	25 µmoles	+	+				
		AAF	1.25 mg			+	+	+	+
	Lu	DMNA	25 µmoles	-	-				
		AAF	1.25 mg			-	-	-	-
	T	DMNA	25 µmoles	-	-				
		AAF	1.25 mg			-	-	-	-
SC	-	DMNA	25 µmoles	-	-				
	-	AAF	1.25 mg			-	-	-	-
	-	Saline	-	-	-				
	-	DMSO	<10%			-	-	-	-

NOTE:
PC = positive control
SC = solvent and chemical controls
AAF = 2-acetylaminofluorene
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes
T-1 = trial 1
T-2 = trial 2
DMSO = dimethyl sulfoxide
(c) = contamination present

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ACTIVATION PLATE TESTS

SPECIES: RAT DATE: 8-30-74

Test	Organ	Compound	Concentration	TA-1535 T-1	TA-1535 T-2		TA-1537 T-1	TA-1537 T-2		TA-1538 T-1	TA-1538 T-2
TC	Li	FDA 71-79	1.50%	-	-		-	-		-	-
	Lu	FDA 71-79	1.50%	-	-		-	-		-	-
	T	FDA 71-79	1.50%	-	-		-	-		-	-

NOTE: TC = test compound
Li = liver
Lu = lung
T = testes
T-1 = trial 1
T-2 = trial 2

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ACTIVATION PLATE TESTS

SPECIES: MONKEY

DATE: 8-30-74

Test	Organ	Compound	Concentration/plate	TA-1535 T-1	TA-1535 T-2	TA-1537 T-1	TA-1537 T-2	TA-1538 T-1	TA-1538 T-2
PC	Li	DMNA	25 µmoles	+	+				
		AAF	1.25 mg			+	+	±	+
	Lu	DMNA	25 µmoles	+/-	+/-				
		AAF	1.25 mg			-	-	-	-
	T	DMNA	25 µmoles	-	-				
		AAF	1.25 mg			-	-	-	-
SC	-	DMNA	25 µmoles	-	-				
	-	AAF	1.25 mg			-	-	-	-
	-	Saline	-	-	-				
	-	DMSO	<10%			-	-	-	-

NOTE:
PC = positive control
SC = solvent and chemical controls
AAF = 2-acetylaminofluorene
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes
T-1 = trial 1
T-2 = trial 2
DMSO = dimethyl sulfoxide
(c) = contamination present

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ACTIVATION PLATE TESTS

SPECIES: MONKEY

DATE: 8-30-74

Test	Organ	Compound	Concentration	TA-1535 T-1	TA-1535 T-2	TA-1537 T-1	TA-1537 T-2	TA-1538 T-1	TA-1538 T-2
TC	Li	FDA 71-79	1.50%	-	-	-	-	-	-
	Lu	FDA 71-79	1.50%	-	-	-	-	-	-
	T	FDA 71-79	1.50%	-	-	-	-	-	-

NOTE: TC = test compound
Li = liver
Lu = lung
T = testes
T-1 = trial 1
T-2 = trial 2

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VIII. NON-ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS: POSITIVE AND SOLVENT CONTROL RESULTS

DATE: 8-16-74

Test	Indicator Strain	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	TA-1535	EMS	0.05 %	10.31	2,628	254.90
	TA-1537	QM	0.01 mg/ml	2.79	59	21.15
	TA-1538	NF	1.25 mg/ml	2.66	43	16.17
SC	TA-1535	SALINE	-	8.75	9	1.03
	TA-1537	SALINE	-	3.70	12	3.24
	TA-1538	DMSO	-	5.17	9	1.74

NOTE: PC = positive control
SC = solvent control
EMS = ethyl methanesulfonate
QM = quinacrine mustard
NF = nitrosofluorene
DMSO = dimthyl sulfoxide

NON-ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS

DATE: 8-16-74

Test	Indicator Strain	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
TC-H	TA-1535	FDA 71-79	1.50%	9.15 (105)	10	1.09
TC-L	TA-1535	FDA 71-79	0.75%	8.54 (98)	16	1.87
TC-H	TA-1537	FDA 71-79	1.50%	2.76 (75)	4	1.45
TC-L	TA-1537	FDA 71-79	0.75%	2.06 (56)	5	2.43
TC-H	TA-1538	FDA 71-79	1.50%	4.09 (79)	15	3.67
TC-L	TA-1538	FDA 71-79	0.75%	3.51 (68)	5	1.42

NOTE: TC-H = test compound high dose
TC-L = test compound low dose
( ) = percent survival

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IX. ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS: POSITIVE AND SOLVENT CONTROL RESULTS

SPECIES: MOUSE

DATE: 7-24-74 — Strain TA-1535

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	DMNA	100 µmoles/ml	5.71	2,233	391.07
	Lu	DMNA	100 µmoles/ml	4.99	49	9.82
	T	DMNA	100 µmoles/ml	7.25	5	0.69
SC	-	DMNA	100 µmoles/ml	10.55	11	1.04
	-	SALINE	-	5.80	11	1.90

DATE: 7-25-74 — Strain TA-1537

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	AAF	1.25 mg/ml	2.67	45	16.85
	Lu	AAF	1.25 mg/ml	1.85	11	5.95
	T	AAF	1.25 mg/ml	2.90	16	5.52
SC	-	AAF	1.25 mg/ml	2.11	6	2.84
	-	DMSO	-	1.83	11	6.01

DATE: 7-26-74 — Strain TA-1538

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	AAF	1.25 mg/ml	2.36	53	22.46
	Lu	AAF	1.25 mg/ml	2.40	16	6.67
	T	AAF	1.25 mg/ml	2.35	10	4.26
SC	-	AAF	1.25 mg/ml	2.75	13	4.73
	-	DMSO	-	2.26 (c)	6	2.65

NOTE: PC = positive control
SC = solvent and chemical controls
AAF = 2-acetylaminofluorene
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes
DMSO = dimethyl sulfoxide

(c) = contamination present

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ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS

SPECIES: MOUSE

Test	Organ	Compound	Concentration	Total Cells/ ml x 10^8	his+ Revertants/ ml	his+ Revertants/10^8 Survivors
DATE: 7-24-74				Strain TA-1535		
TC	Li	FDA 71-79	H	3.26 (56)	7	2.15
		FDA 71-79	L	8.90 (153)	15	1.69
	Lu	FDA 71-79	H	6.39 (110)	2	0.31
		FDA 71-79	L	7.61 (131)	10	1.32
	T	FDA 71-79	H	4.84 (83)	7	1.45
		FDA 71-79	L	6.61 (114)	15	2.27
DATE: 7-25-74				Strain TA-1537		
TC	Li	FDA 71-79	H	2.15 (117)	9	4.19
		FDA 71-79	L	4.03 (220)	19	4.71
	Lu	FDA 71-79	H	1.51 (83)	4	2.65
		FDA 71-79	L	2.04 (111)	5	2.45
	T	FDA 71-79	H	2.16 (118)	4	1.85
		FDA 71-79	L	2.66 (145)	7	2.63
DATE: 7-26-74				Strain TA-1538		
TC	Li	FDA 71-79	H	3.71 (c) (164)	8	2.16
		FDA 71-79	L	1.85 (82)	4	2.16
	Lu	FDA 71-79	H	2.38 (105)	7	2.94
		FDA 71-79	L	2.51 (111)	6	2.39
	T	FDA 71-79	H	2.04 (90)	5 (c)	2.45
		FDA 71-79	L	5.21 (231)	10	1.92

NOTES:
H = high dose
L = low dose
TC = test compound
Li = liver
Lu = lung
T = testes
(c) = contamination present
( ) = percent survival

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ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS: POSITIVE AND SOLVENT CONTROL RESULTS

SPECIES: RAT

DATE: 8-7-74 — Strain TA-1535

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	DMNA	100 µmoles/ml	6.54	4,269	652.75
	Lu	DMNA	100 µmoles/ml	6.46	12	18.46
	T	DMNA	100 µmoles/ml	9.37	3	0.32
SC	-	DMNA	100 µmoles/ml	5.74	11	1.92
	-	SALINE	-	4.17	8	1.92

DATE: 8-8-74 — Strain TA-1537

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	AAF	1.25 mg/ml	1.25	38	30.40
	Lu	AAF	1.25 mg/ml	6.50	33	5.08
	T	AAF	1.25 mg/ml	4.53	18	3.97
SC	-	AAF	1.25 mg/ml	5.62	6	1.07
	-	DMSO	-	5.88	9	1.53

DATE: 8-9-74 — Strain TA-1538

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	AAF	1.25 mg/ml	2.84	165	58.01
	Lu	AAF	1.25 mg/ml	3.95	20	5.06
	T	AAF	1.25 mg/ml	5.09	26	5.11
SC	-	AAF	1.25 mg/ml	3.88	10	2.58
	-	DMSO	-	4.21	8	1.90

NOTE: PC = positive control
SC = solvent and chemical controls
AAF = 2-acetylaminofluorene
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes
DMSO = dimethyl sulfoxide

(c) = contamination present

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ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS

SPECIES: RAT

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
DATE: 8-7-74				Strain TA-1535		
TC	Li	FDA 71-59	H	5.23 (125)	13	2.49
		FDA 71-79	L	5.05 (121)	9	1.78
	Lu	FDA 71-79	H	5.68 (136)	11	1.94
		FDA 71-79	L	6.20 (149)	8	1.29
	T	FDA 71-79	H	11.99 (288)	10	0.83
		FDA 71-79	L	5.98 (143)	12	2.01
DATE: 8-8-74				Strain TA-1537		
TC	Li	FDA 71-79	H	5.68 (97)	23	4.05
		FDA 71-79	L	7.07 (120)	15	2.12
	Lu	FDA 71-79	H	5.32 (90)	9	1.69
		FDA 71-79	L	6.49 (110)	32	4.93
	T	FDA 71-79	H	4.07 (69)	10	2.46
		FDA 71-79	L	5.15 (88)	23	4.47
DATE: 8-9-74				Strain TA-1538		
TC	Li	FDA 71-79	H	3.00 (71)	4	1.33
		FDA 71-79	L	5.77 (137)	8	1.39
	Lu	FDA 71-79	H	3.81 (90)	4	1.05
		FDA 71-79	L	5.08 (121)	6	1.18
	T	FDA 71-79	H	4.84 (115)	15	3.10
		FDA 71-79	L	4.16 (99)	13	3.13

NOTES:
H = high dose
L = low dose
TC = test compound
Li = liver
Lu = lung
T = testes
(c) = contamination present
( ) = percent survival

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ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS: POSITIVE AND SOLVENT CONTROL RESULTS

SPECIES: MONKEY

DATE: 9-5-74 — Strain TA-1535

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	DMNA	100 µmoles/ml	6.49	3,117	480.28
	Lu	DMNA	100 µmoles/ml	6.03	19	3.15
	T	DMNA	100 µmoles/ml	5.63	14	2.49
SC	-	DMNA	100 µmoles/ml	6.40	23	3.59
	-	SALINE	-	5.11	10	1.96

DATE: 9-17-74 — Strain TA-1537

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	AAF	1.25 mg/ml	5.47	84	15.36
	Lu	AAF	1.25 mg/ml	5.64	17	3.01
	T	AAF	1.25 mg/ml	4.57	19	4.16
SC	-	AAF	1.25 mg/ml	5.67	40	7.05
	-	DMSO	-	6.20	44	7.10

DATE: 9-27-74 — Strain TA-1538

Test	Organ	Compound	Concentration	Total Cells/ml x 10^8	his+ Revertants/ml	his+ Revertants/10^8 Survivors
PC	Li	AAF	1.25 mg/ml	6.68	305	45.66
	Lu	AAF	1.25 mg/ml	5.09	52	10.22
	T	AAF	1.25 mg/ml	5.15	33	6.41
SC	-	AAF	1.25 mg/ml	5.07	40	7.89
	-	DMSO	-	4.72	40	8.47

NOTE: PC = positive control
SC = solvent and chemical controls
AAF = 2-acetylaminofluorene
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes
DMSO = dimethyl sulfoxide

(c) = contamination present

Project No. 02468

ACTIVATION SUSPENSION TESTS WITH SALMONELLA INDICATOR STRAINS

SPECIES: MONKEY

Test	Organ	Compound	Concentration	Total Cells/ ml x 10^8	his+ Revertants/ ml	his+ Revertants/10^8 Survivors
DATE: 9-5-74				Strain TA-1535		
TC	Li	FDA 71-79	H	4.29 (84)	13	3.03
		FDA 71-79	L	3.24 (63)	8	2.47
	Lu	FDA 71-79	H	5.96 (117)	16	2.68
		FDA 71-79	L	5.53 (108)	16	2.89
	T	FDA 71-79	H	5.13 (100)	35	6.82
		FDA 71-79	L	4.99 (98)	19	3.81
DATE: 9-17-74				Strain TA-1537		
TC	Li	FDA 71-79	H	6.68 (108)	36	5.39
		FDA 71-79	L	4.94 (80)	15	3.04
	Lu	FDA 71-79	H	5.82 (94)	23	3.95
		FDA 71-79	L	7.26 (117)	19	2.62
	T	FDA 71-79	H	8.71 (140)	45	5.17
		FDA 71-79	L	5.77 (93)	20	3.47
DATE: 9-27-74				Strain TA-1538		
TC	Li	FDA 71-79	H	1.53 (32)	19	12.42
		FDA 71-79	L	1.87 (40)	19	10.16
	Lu	FDA 71-79	H	2.03 (43)	18	8.87
		FDA 71-79	L	3.22 (68)	18	5.59
	T	FDA 71-79	H	1.88 (40)	17	9.04
		FDA 71-79	L	1.44 (31)	13	9.03

NOTES: H = high dose
L = low dose
TC = test compound
Li = liver
Lu = lung
T = testes
(c) = contamination present
( ) = percent survival

Project No. 02468

X. NON-ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4

DATE: 7-29-74

			Strain D4				
Test	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
PC	EMS	1.0 %	4.71	479	315	101.70	66.88
SC	Saline	-	4.39	117	14	26.65	3.19

NOTE: PC = positive control
SC = solvent control
EMS = ethyl methanesulfonate
a = number x 10^5
b = number at 10^{-1} dilution

Project No. 02468

NON-ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4

DATE: 7-29-74

			Strain D4				
Test	Compound	Concentration	Total Population Screened[a]	Number Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
TC	FDA 71-79	H	3.57 (81)	85	11	23.81	3.08
	FDA 71-79	L	4.49 (102)	96	10	21.38	2.23

NOTE: TC = test compound
H = high dose
L = low dose
a = number x 10^5
b = number at 10^{-1} dilution
( ) = percent survival

Project No. 02468

XI. ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4: POSITIVE AND SOLVENT CONTROL RESULTS

SPECIES: MOUSE DATE: 7-29-74

Strain D4

Test	Organ	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
PC	Li	DMNA	150 µmoles/ml	2.90	237	67	81.72	23.10
	Lu	DMNA	150 µmoles/ml	3.23	68	27	21.05	8.36
	T	DMNA	150 µmoles/ml	3.38	61	11	18.05	3.25
SC	-	DMNA	150 µmoles/ml	2.89	42	13	14.53	4.50
	-	SALINE	-	2.75	89	6	32.36	2.18

NOTE: PC = positive control
SC = solvent and chemical controls
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes

a = number x 10^5
b = number at 10^{-1} dilution
(c) = contamination present

ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4

SPECIES: MOUSE DATE: 7-29-74

				Strain D4				
Test	Organ	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
TC	Li	FDA 71-79	H	2.78 (101)	71	5	25.54	1.80
		FDA 71-79	L	2.22 (81)	45	6	20.27	2.70
	Lu	FDA 71-79	H	3.66 (133)	93	7	25.41	1.91
		FDA 71-79	L	3.04 (111)	44	8	14.47	2.63
	T	FDA 71-79	H	1.83 (67)	28	6	15.30	3.28
		FDA 71-79	L	4.06 (148)	41	10	10.10	2.46

NOTE:
TC = test compound
H = high dose
L = low dose
Li = liver
Lu = lung
T = testes
a = number x 10^5
b = number at 10^{-1} dilution
(c) = contamination present
( ) = percent survival

Project No. 02468

ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4: POSITIVE AND SOLVENT CONTROL RESULTS

SPECIES: RAT DATE: 8-5-74

					Strain D4			
Test	Organ	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
PC	Li	DMNA	150 µmoles/ml	2.44	124	74	50.82	23.77
	Lu	DMNA	150 µmoles/ml	2.73	73	10	26.74	3.59
	T	DMNA	150 µmoles/ml	2.72	85	9	31.40	3.42
SC	-	DMNA	150 µmoles/ml	3.29	74	13	22.52	3.98
	-	SALINE	-	2.66	99	10	37.22	3.76

NOTE: PC = positive control
SC = solvent and chemical controls
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes

a = number x 10^5
b = number at 10^{-1} dilution
(c) = contamination present

Project No. 02468

ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4

SPECIES: RAT DATE: 8-5-74

				Strain D4				
Test	Organ	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
TC	Li	FDA 71-79	H	1.72 (65)	91	17	52.91	9.88
		FDA 71-79	L	3.40 (128)	134	9	39.41	2.65
	Lu	FDA 71-79	H	2.65 (100)	93	17	35.10	6.42
		FDA 71-79	L	3.17 (119)	126	22	39.75	6.94
	T	FDA 71-79	H	2.69 (101)	83	20	30.86	7.43
		FDA 71-79	L	2.71 (102)	114	10	42.07	3.69

NOTE:
TC = test compound
H = high dose
L = low dose
Li = liver
Lu = lung
T = testes
a = number x 10^5
b = number at 10^{-1} dilution
( ) = percent survival

Project No. 02468

ACTIVATION SUSPENSION TESTS WITH SACCHAROMYCES INDICATOR STRAIN D4: POSITIVE AND SOLVENT CONTROL RESULTS

SPECIES: MONKEY DATE: 9-20-74

Strain D4

Test	Organ	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
PC	Li	DMNA	150 µmoles/ml	5.67	73	68	12.87	11.99
	Lu	DMNA	150 µmoles/ml	5.46	25	21	4.58	3.85
	T	DMNA	150 µmoles/ml	4.52	16	21(c)	3.54	4.65
SC	-	DMNA	150 µmoles/ml	5.45	25	21	4.59	3.85
	-	SALINE	-	5.46	9	15(c)	1.65	2.75

NOTE: PC = positive control
SC = solvent and chemical controls
DMNA = dimethylnitrosamine
Li = liver
Lu = lung
T = testes

a = number x 10^5
b = number at 10^{-1} dilution
(c) = contamination present

Project No. 02468

ACTIVATION SUSPENSION TESTS
WITH SACCHAROMYCES INDICATOR STRAIN D4

SPECIES: MONKEY DATE: 9-20-74

Strain D4

Test	Organ	Compound	Concentration	Total Population Screened[a]	Number of Convertants[b] Ade+	Try+	Convertants Per 10^5 Survivors Ade+	Try+
TC	Li	FDA 71-79	H	5.81 (106)	21	20	3.61	3.44
		FDA 71-79	L	4.58 (84)	22	0	4.80	-
	Lu	FDA 71-79	H	4.97 (91)	18	46(c)	3.62	9.26
		FDA 71-79	L	4.55 (83)	20	19	4.40	4.18
	T	FDA 71-79	H	6.82 (125)	19	15	2.79	2.20
		FDA 71-79	L	4.50 (82)	17	8	3.78	1.78

NOTE:
TC = test compound
H = high dose
L = low dose
Li = liver
Lu = lung
T = testes
a = number x 10^5
b = number at 10^{-1} dilution
(c) = contamination present
( ) = percent survival

Project No. 02468

XII. SUMMARY OF TEST RESULTS AND INTERPRETATION

Compound FDA 71-79, sodium bicarbonate, was examined for genetic activity in a series of *in vitro* assays. The following results were obtained.

A. Salmonella Test Results

1. Plate tests

At a concentration of 1.5% (w/v), this chemical did not induce reverse mutation in any of the tester strains directly or in the presence of organ homogenate preparations.

2. Non-activation suspension tests

All tests with FDA 71-79 were negative.

3. Activation suspension tests

All tests with FDA 71-79 were negative.

B. Saccharomyces Test Results

1. Non-activation suspension tests

All tests with FDA 71-79 were negative.

2. Activation suspension tests

The high dose level of FDA 71-79 in the presence of rat liver homogenates appeared elevated when compared to the control frequencies. Similar elevations were not observed with the same dose level in the presence of mouse or monkey liver homogenates; however, elevated frequencies with rat liver preparations were also obtained for compound FDA 71-36 without similar increases for monkey and mouse tests. It is my opinion that the increased frequencies with rat liver homogenates are not representative of genetic activity induced by FDA 71-79 but were generated by some peculiarity in the test system. The fact that no positive results were obtained from any other test in the evaluation series tends to support this conclusion.

Submitted by:

David Brusick, Ph.D.

David Brusick, Ph.D.
Director, Department of Genetics

APPENDIX

SUMMARY OF TESTS EVALUATING DMSO FOR GENETIC ACTIVITY IN SALMONELLA AND SACCHAROMYCES

Litton BIONETICS

COMPOUND DIMETHYSULFOXIDE

A. Suspension Tests

Test	Activation Species[a]	Activation Organ[b]	Salmonella Reversion Frequencies ($\times 10^{-8}$) TA-1535	Salmonella Reversion Frequencies ($\times 10^{-8}$) TA-1538	Saccharomyces D4 Conversion Frequencies ($\times 10^{-5}$) Ade^+	Saccharomyces D4 Conversion Frequencies ($\times 10^{-5}$) Try^+
Non-activation						
Control (-C)	-	-	0.74	0.88	32.51	4.34
High Dose[c]	-	-	1.91	1.05	28.32	2.95
Low Dose[d]	-	-	0.53	1.37	40.73	0.49
Activation						
Control (+C)	-	-	1.80	0.36	38.27	2.47
Control (-C)	-	-	1.43	1.04	37.12	2.64
High Dose[c]	M	Li	0.34	1.07	47.77	2.75
	M	Lu	0.59	0.58	36.29	1.39
	M	T	0.62	0.30	34.35	1.94
Lose Dose[d]	M	Li	-	0.87	34.02	1.18
	M	Lu	0.43	3.14	42.30	1.40
	M	T	0.11	0.39	45.95	2.32

Note: (-C) = solvent control and (+C) = test chemical control without homogenate

a M = mouse, Mo = monkey, R = rat

b Li = liver, Lu = lung, T = testes

c Bacteria = 3%, Yeast = 5%

d Bacteria = 1.5%, Yeast = 2.5%

Litton BIONETICS

COMPOUND DIMETHYSULFOXIDE

B. Plate Tests

Test	Activation: Species[a]	Activation: Organ[b]	Salmonella Responses: TA-1535	TA-1537	TA-1538
Non-activation					
Control (-C)	-	-	-	-	-
Test compound (3%)	-	-	-	-	-
Activation					
Control (+C)	-	-	-	-	-
Control (-C)	-	-	-	-	-
Test compound (3%)	M	Li	-	-	-
	M	Lu	-	-	-
	M	T	-	-	-
	R	Li	-	-	-
	R	Lu	-	-	-
	R	T	-	-	-
	Mo	Li	-	-	-
	Mo	Lu	-	-	-
	Mo	T	-	-	-

Note: (-C) = solvent control and (+C) = chemical control without homogenate

a M = mouse
Mo = monkey
R = rat

b Li = liver
Lu = lung
T = testes